onto the main roll 66 position. The transfer bar 44 automatically resets itself. The transfer bar 44 is spring loaded so as to be disposed with the transfer bar legs 46 pressed upward against the stub roll 68 or the stub roll core 84. The transfer bar legs 46 are adapted to be disposed inward of the roll hubs 34 so the bar 88 of the transfer bar 44 will have a positive stop at a more rigid location, in this case, the top of the electronics module 132 (Fig. 2).

[0068] Figure 7C shows the extension springs 126, 128 which tend to maintain the transfer bar legs 46 in contact with the stub roll 68 or stub roll core 84. The transfer bar 44 contains the two extension springs 126, 128. The spring forces are typically 0.05 lbf to 0.5 lbf in the bar 44 lowered position and 0.2 lbf to 1.0 lbf in the bar 44 raised position. In this embodiment, the spring forces are 0.2 lbf in the lowered position an 0.43 lbf in the raised position. The force of the two springs 126, 128 is additive so that the transfer bar 44 is subject to a total spring force of 0.4 lbf in the lowered position and 0.86 lbf in the raised position.

[0069] While modular units (Fig. 7D) such as the electronics module 132, the motor 56 module, and the battery case 150, are removable, they fit, or "snap" together so that the top of the electronics unit 132, the top of the motor 56 module and remaining elements of the "floor" 148 of the dispensing unit 20 form a smooth, cleanable surface. Paper dust and debris tend to accumulate on the floor 148 of the dispenser 20. It is important that the dispenser 20 is able to be easily cleaned as part of the maintenance procedure. A quick wiping with a damp cloth will sweep out and pick up any undesirable accumulation. The removable modular dispensing shelf 64 may be removed for rinsing or wiping.

[0070] The feed roller 50 may be driven by a motor 56 which in turn may be driven by a battery or batteries 58, driven off a 100 or 220V AC hookup, or driven off a transformer which is run off an AC circuit. The batteries may be non-rechargeable or rechargeable. Rechargeable batteries may include, but not be limited to, lithium ion, metal hydride, metal-air, nonmetal-air. The rechargeable batteries may be recharged by, but not limited to, AC electromagnetic induction or light energy using photocells.

[0071] A feed roller 50 serves to feed the paper towel being dispensed onto the curved dispensing ribs 52. A gear train (not visible) may be placed under housing 86, (Fig. 3) for driving the feed roller. A control unit 54 (Fig. 3) for a motor

56 (Fig. 3) may be utilized. A proximity sensor (not shown) or a hand-operated switch 64 may serve to turn the motor 56 on and off.

[0072] As an enhancement and further development of a system for delivering paper towel to the end user in as cost effective manner and user-friendly manner as possible, an automatic means for dispensing the paper towel is desirable, making it unnecessary for a user to physically touch a knob or a lever. Therefore, a more hygienic dispenser is present. This dispenser will contribute to less transfer of matter, whether dirt or bacteria, from one user to the next. The results of washing ones hands will tend to be preserved and hygiene increased.

[0073] An electronic proximity sensor is included as part of the paper towel dispenser. A person can approach the paper towel dispenser, extend his or her hand, and have the proximity sensor detect the presence of the hand. Upon detection of the hand, a motor is energized which dispenses the paper towel. It has long been known that the insertion of an object with a dielectric constant into a volume with an electromagnetic field will tend to modify the properties, which the electromagnetic field sees. The property of the hand, a dielectric constant close to that of water, is enough to alter the net capacitance of a suitable detector circuit.

[0074] An embodiment of the invention comprises a balanced bridge circuit. See Figure 8A. The component U1A 90 is a comparator (TLC3702 158) configured as an oscillator. The frequency of oscillation of this component, U1A 90, of the circuit may be considered arbitrary and non-critical, as far as the operation of the circuit is concerned. The period of the oscillator is set by the elements Cref 92, Rhys 94, the trim resistance, Rtrim 96, where the trim resistance may be varied and the range resistors Rrange 152 are fixed. The resistors Rrange 152 allow limits to be placed on the range of adjustment, resulting in an easier adjustment. The adjustment band is narrowed, since only part of the total resistance there can be varied. Consequently a single potentiometer may be used, simplifying the adjustment of Rtrim 96. A value for Rrange 152 for the schematic shown in Figure 8A might be 100 kΩ. Rtrim 96 might have an adjustment range of 10 kΩ to 50 kΩ. The output signal at pin 1 98 of component U1A 90 is a square wave, as shown in Figure 9A. Cref 92 is charged by the output along with ANT 100, both sustaining the oscillation and measuring the capacitance of the adjacent free space. The signals resulting from the charging action are applied to a second comparator, U1B 102, at pin 5 104 and pin

6 106 (Fig. 8A). These signals appear as exponential waveforms, as shown in Figure 9B and Figure 9C.

[0075] The simplest form of a comparator is a high-gain differential amplifier, made either with transistors or with an op-amp. The op-amp goes into positive or negative saturation according to the difference of the input voltages because the voltage gain is typically larger than 100,000, the inputs will have to be equal to within a fraction of a millivolt in order for the output not to be completely saturated. Although an ordinary op-amp can be used as comparator, there are special integrated circuits intended for this use. These include the LM 306, LM311, LM393 154 (Fig. 8A), LM393V, NE627 and TLC3702 158. The LM393V is a lower voltage derivative of the LM393 154. The LM393 154 is an integrated circuit containing two comparators. The TLC3702 158 is a micropower dual comparitor with CMOS push-pull 156 outputs. Figure 8B (prior art) is a schematic which shows the different output structures for the LM393 and the TLC3702. The dedicated comparators are much faster than the ordinary op-amps.

[0076] The output signal at pin 1 98 of component U1A 90, e.g., a TL3702 158, is a square wave, as shown in Figure 2A. Two waveforms are generated at the inputs of the second comparator, U2B 102. The first comparator 90 is running as an oscillator producing a square-wave clocking signal, which is input, to the clock input of the flip-flop U2A 108, which may be, for example, a Motorola D flip-flop, No. 14013.

[0077] Running the first comparator as a Schmitt trigger oscillator, the first comparator U1A 90 is setup to have positive feedback to the non-inverting input, terminal 3 110. The positive feedback insures a rapid output transition, regardless of the speed of the input waveform. Rhys 94 is chosen to produce the required hysteresis, together with the bias resistors Rbias1 112 and Rbias2 114. When these two bias resistors, Rbias1 112, Rbias2 114 and the hysteresis resistor, Rhys 94, are equal, the resulting threshold levels are 1/3 V+ and 2/3 V+, where V+ 158 is the supply voltage. The actual values are not especially critical, except that the three resistors Rbias1 112, Rbias2 114 and Rhys 94, should be equal, for proper balance. The value of 294 kΩ maybe used for these three resistors, in the schematic shown in Figure 8A.